Space Weather Technical Forecast

Issued on Wednesday, 21 June 2023 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1/R2 Radio Blackouts Likely throughout. Slight Chance of Minor Geomagnetic Storm G1 Days 2 & 3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been High in the last 24 hours, with an impulsive X1.1 flare observed at 20/1709UTC and originating from AR3341.There are now up to twelve sunspot regions on the disc. AR3340 displayed a rather large north-south extent so has been partitioned with a separate, at the moment unnumbered, group to its south. AR3333 has lost some magnetic complexity and is now a Dsi/Beta. AR3335 remains the largest and most complex region on the disk but remains stable. AR3338's trailing region has faded so it has been reanalysed as an Hsx/Alpha. AR3341 has simplified a little and has been downgraded to a Cso/Beta. AR3342 is approaching the west limb. AR3343 has faded to plage. Three unnumbered regions will be monitored for development.
There are numerous filaments on the disc at present. Though the largest ones appear stable and there is no evidence of any resulting CME in coronagraph imagery.
At present then, there are no new confirmed Earth-directed CMEs.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, showed probable ongoing connection to a negative polarity coronal hole high speed stream with speeds between 400 and 450km/s. The phi angle was accordingly mostly negative (towards the Sun). The solar wind density was mostly around average, while the IMF was weak, below 8nT. The north-south component, Bz, ranged from +6 and -6nT. The net effect of the above solar wind measures was Quiet with one Unsettled interval at 20/21-24UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at Background levels.
High energy electron flux (greater than 2MeV), as observed by GOES16, ranged between mainly Moderate and High flux, with a diurnal peak of 2130pfu observed at 20/1725UTC. The associated 24-hour fluence displayed a slight rising trend but remained below the Active threshold. The observed fluence at 21/0001UTC was 6.82e7.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Moderate, with isolated or occasional M-class flares and a slight chance of X-class flares. The risk may reduce later as AR3342 rotates over the west limb.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast carries lower-than-average confidence. While mostly Quiet to Unsettled conditions are expected overall, there is a chance of an Active or even a slight chance of a G1/Minor Storm interval on Days 2 & 3 (22nd & 23rd), under the combined influence of the ongoing fast wind and also perhaps a glancing blow from some minor peripheral CMEs.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with a daily Slight Chance of S1 or greater.
High energy electron flux (greater than 2MeV) is expected to become confined to low and moderate levels, and the 24-hour integrated fluence to remain most likely under the Active threshold.

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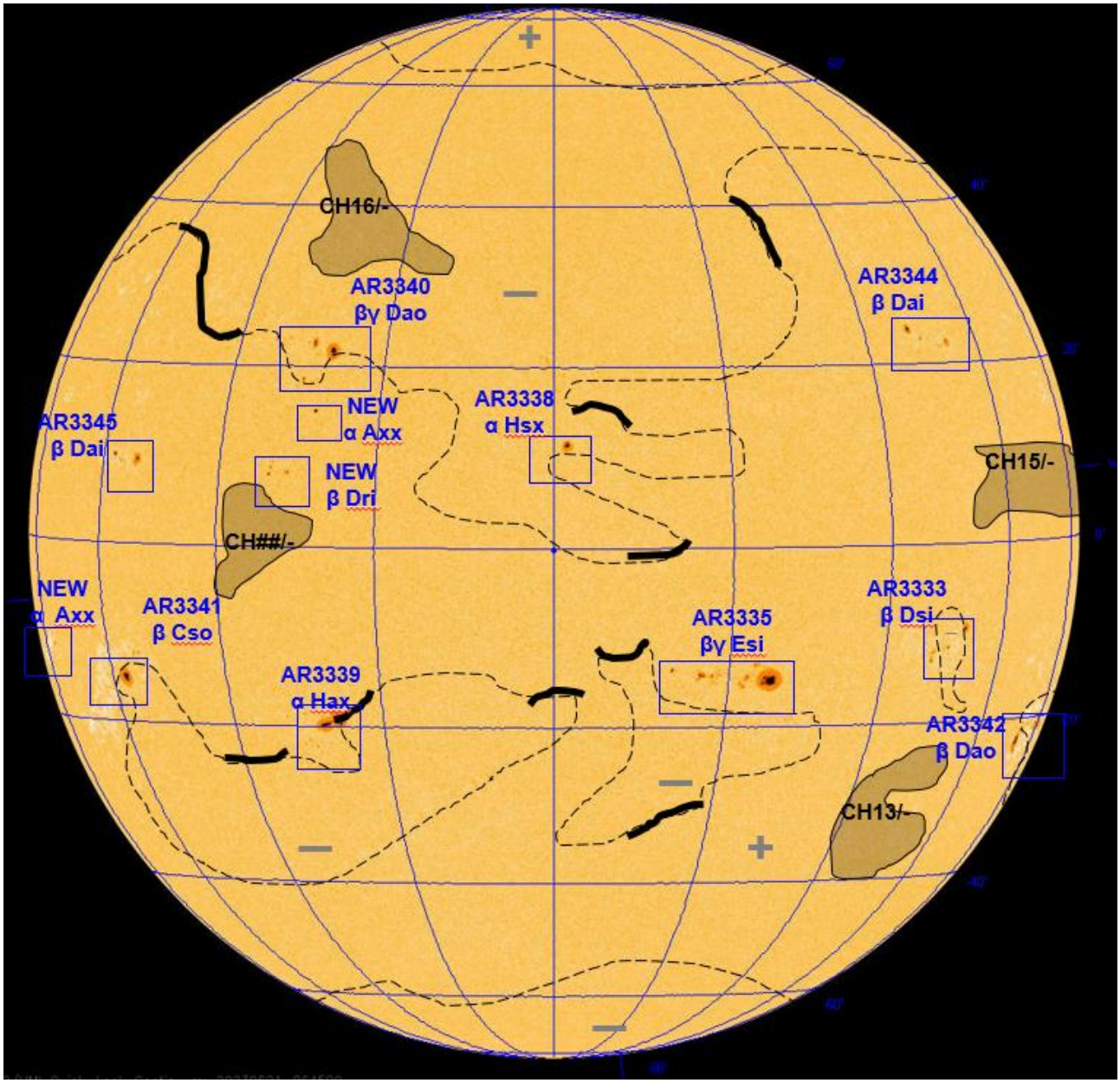
Figure 1. Solar Analysis Valid 21/0700UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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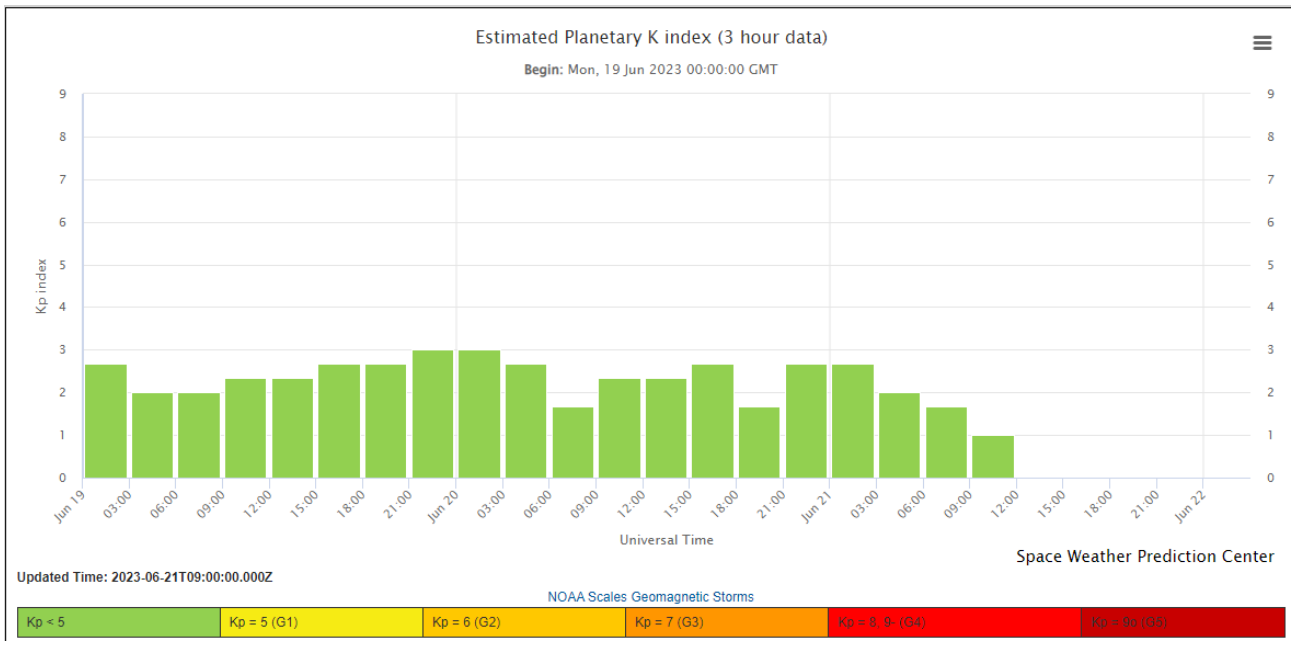
Geomagnetic Storms:

The geomagnetic forecast carries low confidence for the upcoming forecast period. Persistence is little help due to coronal holes this rotation being in different positions to previous rotations.
Earth is likely under influence of a weak high speed stream from negative coronal hole 13.
Winds are likely to east to background later Day 2 into Day 3.
However, the Sun has released several peripheral CMEs in recent days. These are showing in the latest MOSWOC Enlil and ensemble output but the model has proved very volatile in this respect in recent runs, any weak glancing blows are most likely on Day 2 or early Day 3.
Mostly Quiet to Unsettled conditions are expected overall. However, there is a chance of an Active or even a slight chance of a G1/Minor Storm interval on Days 2 & 3 (22nd & 23rd), under the combined influence of the fast wind and also perhaps a glancing blow from some minor peripheral CMEs.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections- Nil

Figure 2: Estimated K-index from NOAA SWPC


Estimated Planetary K index (3 hour data)
Begin: Mon, 19 Jun 2023 00:00:00 GMT
Kp index
Universal Time
Space Weather Prediction Center
Updated Time: 2023-06-21T09:00:00.000Z
NOAA Scales Geomagnetic Storms
Kp < 5
Kp = 5 (G1)
Kp = 6 (G2)
Kp = 7 (G3)
Kp = 8, 9- (G4)
Kp = 9o (G5)

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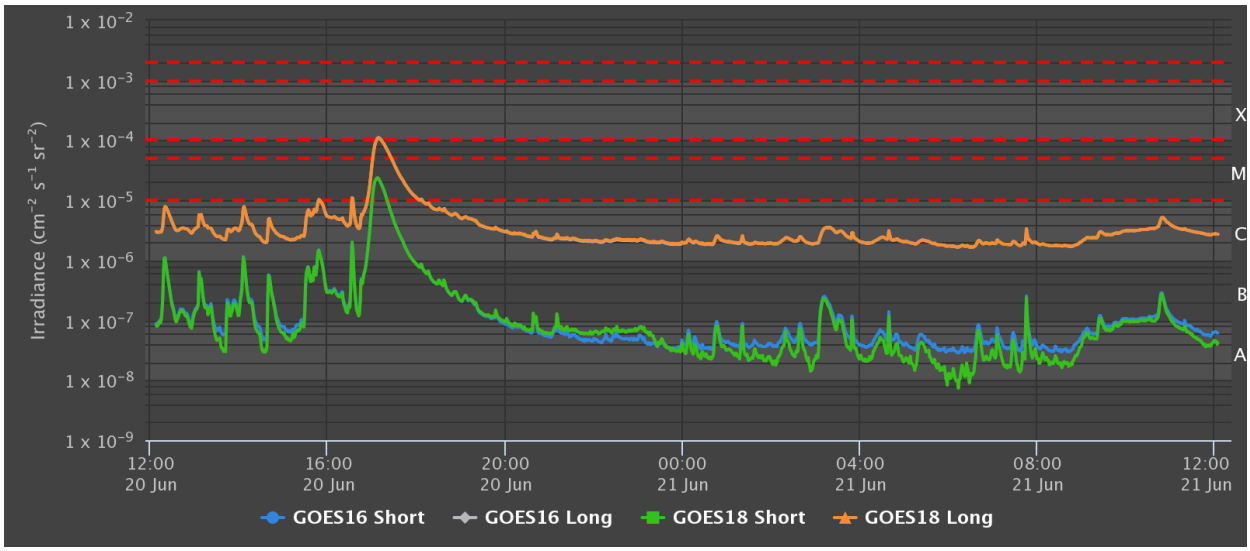
Radio Blackouts - X-Ray Flares:
The number of sunspot regions on the Earth-facing disc is now twelve. AR3341 generated an X-class flare at 20/1709UTC. This region has since simplified to a Cso/Beta. Most of the regions on the disk have remained stable, with no significant development observed recently. However, the large number of regions on the disk with ongoing potential for growth suggests the further M class flares are likely with a slight chance of X class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	55	51
Very Active	R3 to R5 X Class	Yes	5	5	5	5

Figure 3: GOES18 X-Ray flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux is expected to remain at Background levels. However, there is a daily slight chance of reaching the S1/Minor Storm threshold given the number and complexity of some sunspot regions, perhaps increasing very slightly over time.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The upcoming forecast carries greater-than-average uncertainty given the number of possible minor interruptions from peripheral CMEs, as hinted at in the MOSWOC Enlil ensemble, which is proving volatile from run to run.
There also remains uncertainties regarding the duration of slightly elevated solar winds, this is due to lack of reliable persistence data from previous rotations.
All considered and with an absence of significant geomagnetic activity over the following days, the high energy electron flux is most likely to become confined to low and moderate levels, the result being the fluence more likely than not to remain under the Active threshold and perhaps display a slight decreasing trend over time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	20	20	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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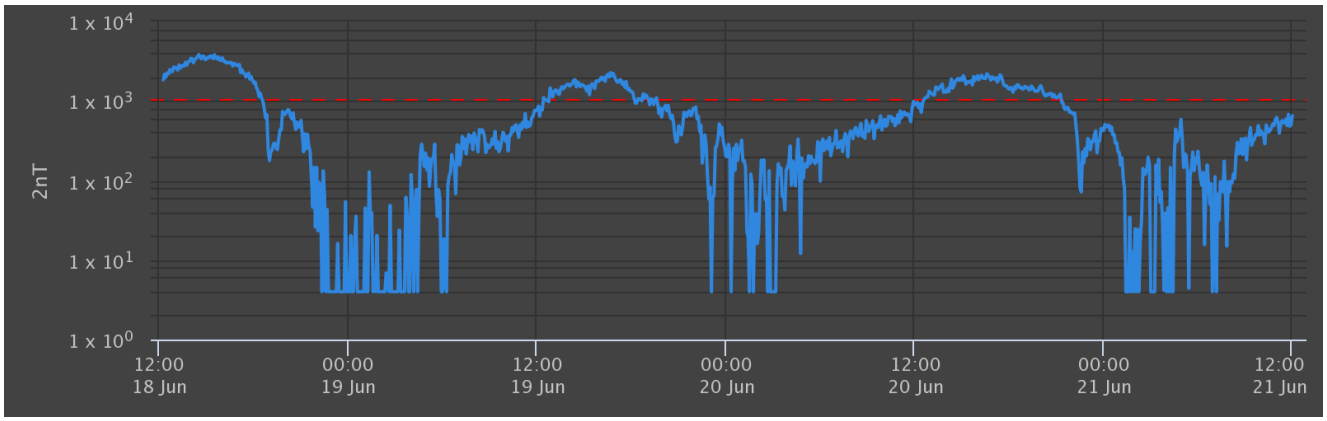
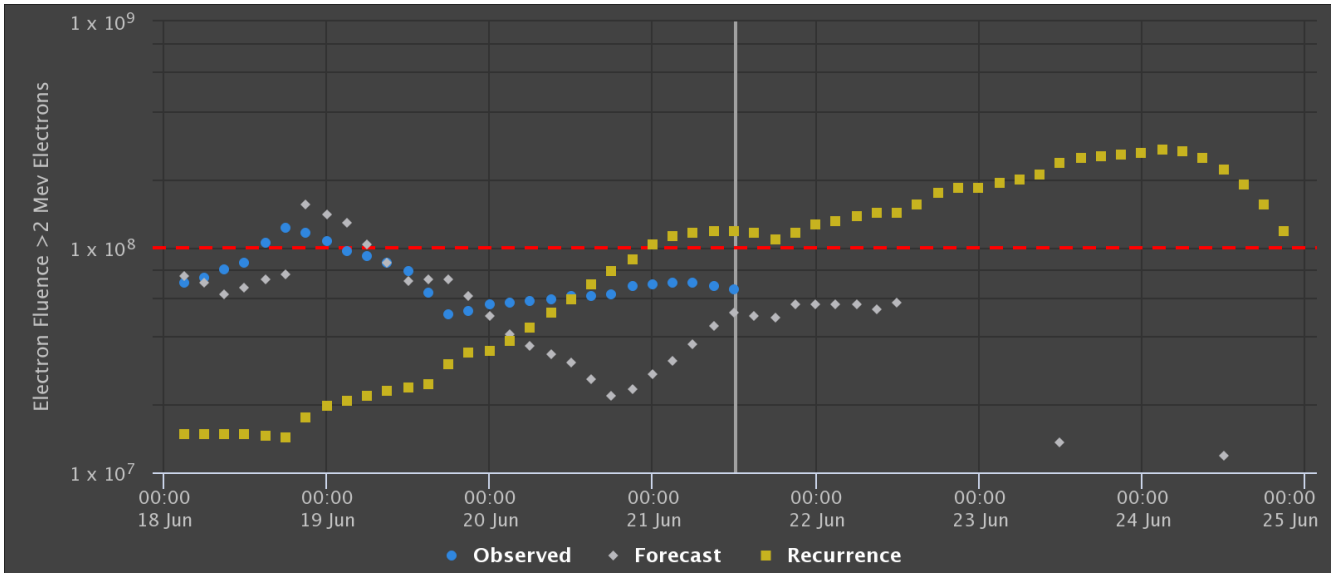
Figure 4: GOES16 ElectronFlux and MOSWOC REF Model from 1200UTC 18th June.





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